

# *Smithia yehii* (Leguminosae, Papilionoideae), a new species from Taiwan

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## Abstract

A new species of *Smithia* Aiton, *S. yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng, **sp. nov.** from the wetlands of Taiwan is reported in this article. This species was mistakenly identified as *S. sensitiva* Aiton, but can be distinguished by its pale yellow corolla (vs. vivid yellow), often smaller flowers and shorter style. There is also a color gradient on the adaxial surface of the leaflets between young and mature leaves. Surface sculpture of pollen of *S. yehii* has significantly larger perforations, and muri are wider than those of *S. sensitiva*. An identification key to the *Smithia* taxa of Taiwan and *S. sensitiva* is presented.

## Keywords

endangered (EN), macro-morphology, pollen morphology, scanning electron microscopy (SEM), *Smithia ciliata* Royle, *S. sensitiva* Aiton

## Introduction

The genus *Smithia* Aiton belongs to the tribe Aeschynomeneae (Benth.) Hutch., Papilionoideae DC., Leguminosae Juss. (LPWG 2017) and contains c. 20 species (Sa and Delgado-Salinas 2010). The genus is widely distributed in the tropics, chiefly in Asia and Madagascar (Huang and Huang 1987; Klitgaard and Lavin 2005). There are fourteen species in India (Balan and Predeep 2017), five species in China (Sa and Delgado-Salinas 2010), and two species in Taiwan (Huang and Ohashi 1977; Huang and Huang 1987, 1993).

The first record of Taiwanese *Smithia* was made by Forbes and Hemsley (1887), in which they recorded the species, *S. sensitiva* Aiton. Next, Hayata (1911) described a new species, *S. nagasawai* Hayata, based on its truncated or round apex of bracts, which differ from the acute apex of bracts in the similar *S. ciliata* Royle. Later, Hosokawa (1936) recorded *S. ciliata* in central Taiwan. Huang and Ohashi (1977) treated *S. nagasawai* as a synonym of *S. ciliata*. Since then, all authors have treated only two species of *Smithia* in Taiwan in subsequent papers (Huang and Ohashi 1977; Huang and Huang 1987, 1993): *S. sensitiva* and *S. ciliata*.

During a recent field and herbarium investigation, we noticed that the identity of *S. sensitiva* was somewhat controversial in Taiwan. Specimens initially identified in the field as *Smithia sensitiva* had vivid yellow flowers up to 1.5 cm long with styles up to 8 mm long (Aiton 1789; Efloraofindia 2007 onwards; Sa and Delgado-Salinas 2010; Balan and Predeep 2017). However, all specimens previously identified as *S. sensitiva* in Taiwan had smaller pale yellow flowers with shorter styles. Hence, it was suspected the Taiwanese population was likely an unknown taxon distinct from *S. sensitiva*. The aim of the present study was to elucidate the taxonomic status of this taxon by morphological and palynological approaches.

## Materials and methods

### Morphological comparison

We compared three *Smithia* taxa including Taiwanese taxa, viz. *S. ciliata* and the unknown taxon, together with its similar species, viz. *S. sensitiva*, which were collected from herbaria (see additional specimens examined). Morphological measurements were made on both fresh and dried materials. For the morphological description, the terminology followed the studies of Sa and Delgado-Salinas (2010) and Balan and Predeep (2017).

### Herbarium resources

Herbarium acronyms followed Index Herbariorum (Thiers 2022, continuously updated). Voucher specimens collected for the current study were deposited in TCF and TNM. Physical or digital specimens from the following herbaria were examined: HAST, PH, TAI, TAIE, TAIF, TCF and TNM. Type information of *S. sensitiva* followed the study of Balan and Predeep (2017).

### Pollen morphology

We compared the pollen morphology of the unknown taxon with that of its similar species, *S. sensitiva*, and information about the voucher specimens is provided in Table 1. Pollen materials were treated according to the methods of Schols et al. (2004) and

**Table 1.** Specimens referenced for *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng and *S. sensitiva* Aiton pollen morphology.

Taxon	Location	Coordinate	Altitude	Date	Voucher
<i>S. yehii</i>	TAIWAN. Miaoli County Tunghsiao Township, Tunghsiao Township 14 <sup>th</sup> Cemetery	24.44718°N, 120.69563°E	81 m	17 Dec 2021	<i>Chih Y.Chang 3620</i> (TCF, TNM)
<i>S. sensitiva</i>	THAILAND. Chiang Mai Province Samoeng district, Samoeng Forest	18.87321°N, 98.78213°E	1100 m	24 Nov 2018	<i>C.M.Wang 17941</i> (TNM)
	CHINA. Guangdong Province Huidong County, Gutianshan Nature Reserve	23.19310°N, 114.78134°E	220 m	8 Sept 1984	<i>Huidong collector team 730</i> (TNM)

Halbritter (1998). Pollen grains were obtained from herbarium materials and isolated anthers were rehydrated overnight. Whole anthers were fixed in 2% glutaraldehyde overnight, then treated with DMP (2, 2-dimethoxypropane) for 30 minutes, and transferred to acetone for 30 minutes before critical-point drying (CPD). Dried pollen was mounted on a stub and sputter coated with gold for > 100 s (Quorum SC7620) and examined by scanning electron microscopy (Hitachi S-3400N). The terminology for pollen shape, size, and exine ornamentation followed the recommendations of Erdtman (1952) and Halbritter et al. (2018).

The quantitative palynological traits were measured and their means and standard deviations were calculated. For each quantitative character, the Shapiro-Wilks normality test was first used to check the distribution, then an independent sample *t*-test was performed after logarithmic transformation (Kim 2015). All analyses were done using the PASW Statistics ver. 18 software (Sarma and Vardhan 2018).

## Distribution map

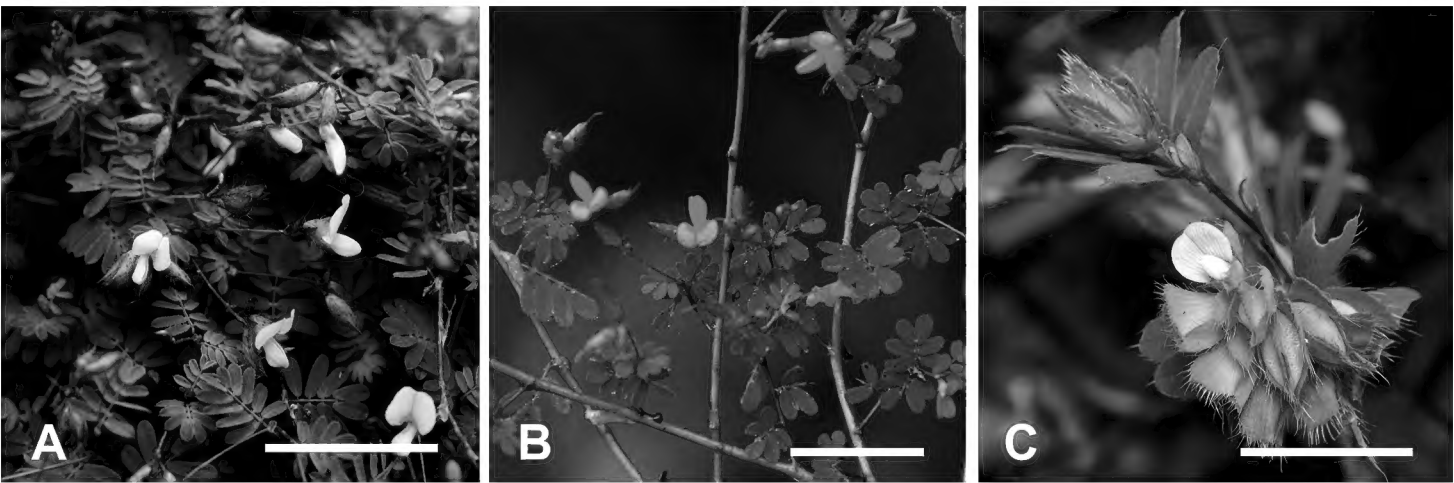
The occurrence data was based on herbarium specimens. A distribution map was generated by using the package of Lin (2018) for QGIS ver. 3.4.

## Results and discussion

We compared the macro-morphology of the three *Smithia* taxa, *S. sensitiva*, *S. ciliata* and *S. yehii* (Fig. 1, Table 2) and the pollen morphology between *S. sensitiva* and *S. yehii* (Fig. 2, Table 3).

## Macro-morphological differences

*Smithia ciliata* is distinctly different from other species in that its inflorescences often have more than twelve flowers (Fig. 1C), whereas those of *S. sensitiva* and *S. yehii* have fewer than seven flowers (Fig. 1A, B). The calyx of *S. ciliata* is densely ciliate at the margin, and membranous with clearly reticulate veins, while *S. sensitiva* and *S. yehii* have entire margins and scarious parallel veins. The pods of *S. ciliata* are slightly orbicular and often more



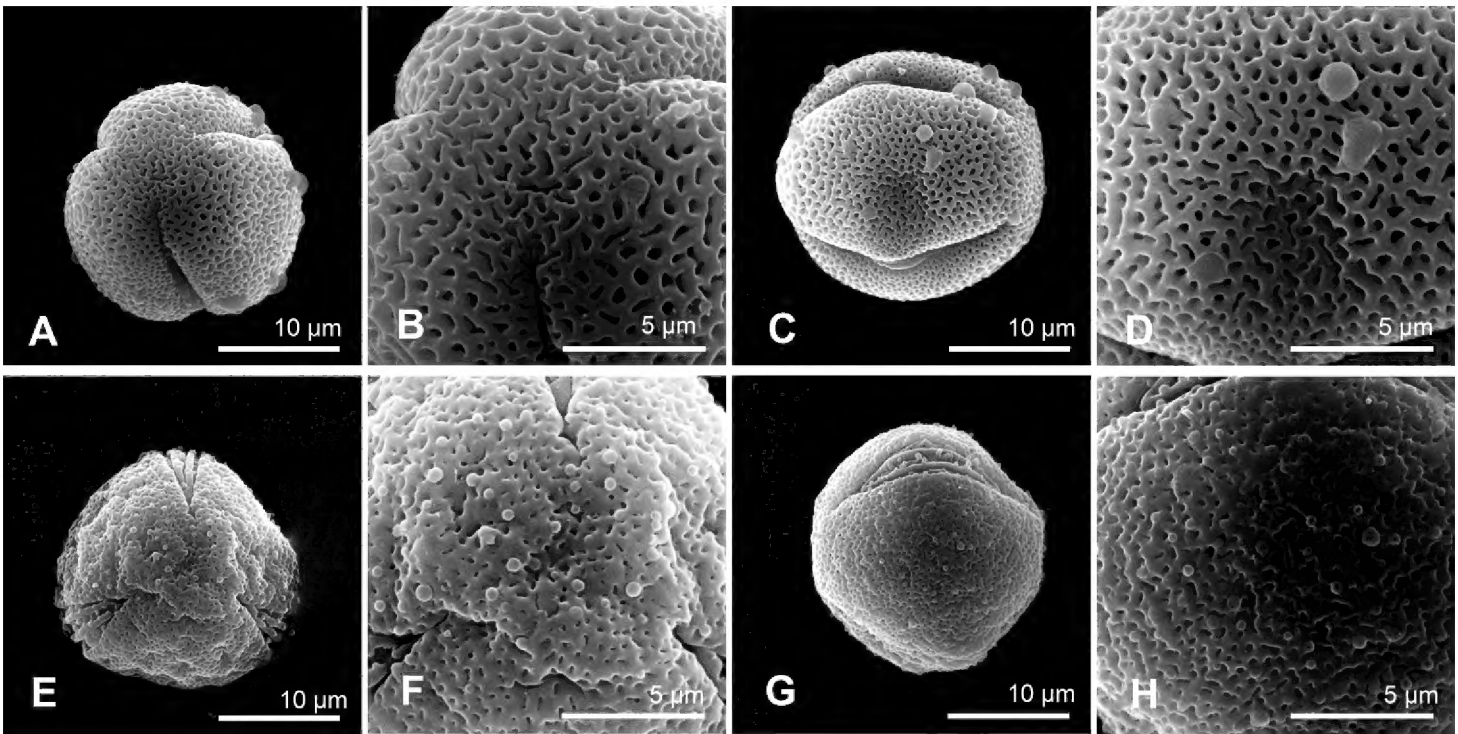
**Figure 1.** Comparison of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng and its similar species. Scale bars: 3 cm **A** *S. yehii* (photo by C.M.Wang, from Miaoli, Taiwan) **B** *S. sensitiva* Aiton (photo by Chih Y.Chang, from Chiang Mai, Thailand) **C** *S. ciliata* Royle (photo by C.M.Wang, from Chiayi, Taiwan).

**Table 2.** Summary of diagnostic characters of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng and its similar species.

Characters	<i>S. yehii</i>	<i>S. sensitiva</i> (Efloraofindia 2007; Sa and Delgado-Salinas 2010; Balan and Predeep 2017)	<i>S. ciliata</i> (Huang and Huang 1993; Sa and Delgado-Salinas 2010)
Leaflet pairs	(2)4–9	4–11	4–7
Leaflet size	3.5–7.0 × 1.2–2.3 mm	4–15 × 2–3 mm	6–12 × 2–4 mm
Leaflets, adaxial color	dark green at apex, light green at base when young and mature	same color between apex and base	same color between apex and base
Flowers, number per raceme	1–7	3–6	12 to many
Flowers	0.7–1.0 cm long	0.8–1.5 cm long	c. 1 cm long
Calyx	entire at margin, scarious, with parallel veins	entire at margin, scarious, with parallel veins	ciliate at margin, membranous, with reticulate veins
Corolla	pale yellow	vivid yellow	white or yellow
Style	3.4–4.1 mm long	c. 8 mm long	c. 2.5 mm long
Pod shape and size	more or less straight, 0.5–0.8 cm long	more or less straight, c. 0.4 cm long	slightly orbicular, 1–1.5 cm long
Jointed number of pod	(4)6–7	4–6	6–8
Distribution	endemic to Taiwan, in wetlands and open places, at elevations of < 300 m	widely distributed in Australia, India, Madagascar and Tropical Asia, in field margins, wetlands; at elevations of < 1000 m	widely distributed in Taiwan, China, Bhutan, India, Japan, Malaysia, Nepal, Philippines, Thailand and Vietnam. Taiwan, in margin of thickets, at elevation of 1,000–1,800 m

than 1.1 cm long, whereas both *S. sensitiva* and *S. yehii* are more or less straight and usually less than 1 cm long (Huang and Huang 1993; Sa and Delgado-Salinas 2010) (Table 2).

Compared with *S. sensitiva*, the corolla of *S. yehii* is pale yellow (Fig. 1A); whereas *S. sensitiva* has a vivid yellow corolla (Fig. 1B). *S. yehii* often has smaller flowers (0.7–1.0 cm long) than *S. sensitiva* (0.8–1.5 cm long). In addition, *S. yehii* has a shorter style



**Figure 2.** Comparison of the pollen morphology of *Smithia* Aiton **A–D** *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng **E–H** *S. sensitiva* Aiton **A, E** polar view **B, F** exine ornamentation of polar view **C, G** equatorial view **D, H** exine ornamentation of equatorial view.

**Table 3.** Comparison of pollen characters of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng and *S. sensitiva* Aiton.

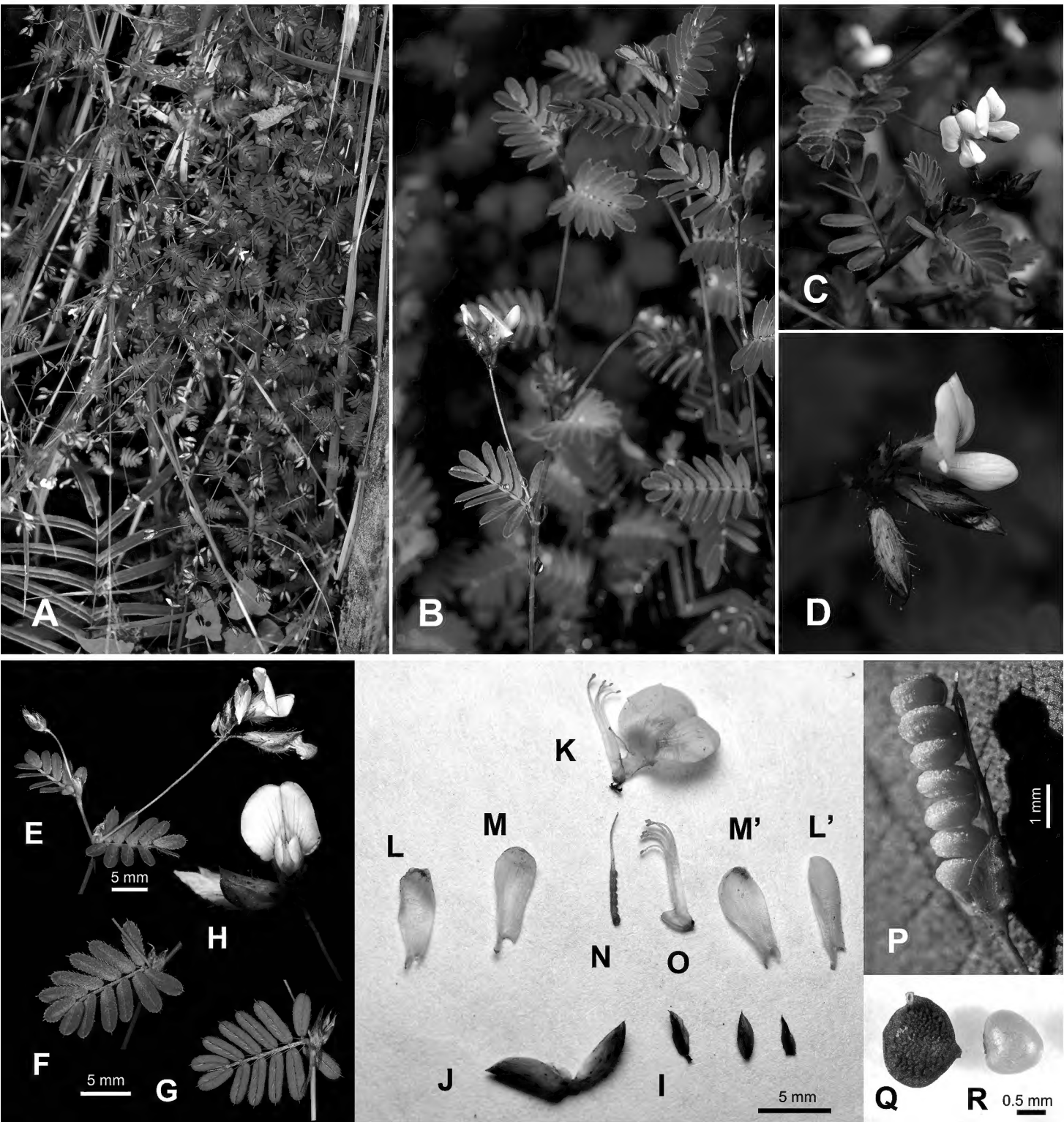
Taxon	Polar axis length (μm)	Equatorial axis length (μm)	P/E ratio	Exine ornamentation	Murus wide (μm)	Perforate size (μm)
<i>S. yehii</i>	21.2±1.0 (19.6–22.7)	19.5±1.6 (16.5–21.9)	1.1±0.1 (0.9–1.3)	perforate	0.5±0.1 (0.3–1.1)	0.4±0.1 (0.2–0.6)
<i>S. sensitiva</i>	21.0±1.4 (18.5–23.5)	18.4±1.6 (15.9–20.4)	1.1±0.1 (0.9–1.3)	perforate	0.4±0.1 (0.3–0.7)	0.2±0.1 (0.1–0.3)

(3.4–4.1 mm) than *S. sensitiva* (c. 8 mm) (Efloraofindia 2007; Sa and Delgado-Salinas 2010) (Table 2). Leaves of *S. yehii* are usually smaller (3.5–7.0 mm long) with fewer than nine pairs of leaflets, while *S. sensitiva* often has up to eleven pairs of leaflets and they are larger (up to 1.5 cm) (Efloraofindia 2007; Sa and Delgado-Salinas 2010) (Table 2). Furthermore, *S. yehii* has color variations on parts of the adaxial surface of the leaflets, with dark green at the apex and light green at the base (Figs 1A, 3B, F); older leaflets are consistently dark green. *S. sensitiva* leaflets remain consistently pale green (Fig. 1B).

Pollen morphological differences

The pollen grains of both *S. yehii* and *S. sensitiva* are small, tricolporate, and spheroidal with perforated exine ornamentation. *Smithia yehii* has significantly larger exine perforations (0.2–0.6 μm) than *S. sensitiva* (0.1–0.3 μm) ( $p = 0.000^{***}$ ), and *S. yehii* has significantly larger muri (width of 0.3–1.1 μm) than *S. sensitiva* (0.3–0.7 μm) ( $p = 0.044^{*}$ ) (Fig. 2, Tables 3, 4). The pollen characteristics also support the two taxa as distinct species.





**Figure 3.** *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng **A** habitat **B, C** habit **D, E** raceme **F** (leaf adaxial) **G** (leaf abaxial) **H** flowers **I** bracteoles **J** calyx **K** standard and part of diadelphous stamen **L** wing **M** keel **N** gynoecium **O** diadelphous stamen **P** pod **Q** joint of pod **R** seed. Voucher **A, D–H** Chih Y.Chang 3620 (TCF) **B, L–R** C.M. Wang 17247 (TNM).

Key to *Smithia yehii* and its similar species (modified from Huang and Huang (1993), and Sa and Delgado-Salinas (2010)

- 1        Inflorescences often with more than 12 flowers, calyx ciliate at margin, membranous, with reticulate veins; pods slightly orbicular, more than 1.1 cm long ..... *S. ciliata*
- Inflorescences with fewer than 7 flowers, calyx entire at margin, scarious, with parallel veins; pods more or less straight, less than 1 cm ..... 2

- 2Corolla pale yellow, flowers often less than 1 cm long (0.7–1.0 cm), style less than 5 mm long (3.4–4.1 mm); leaflets adaxial dark green at apex and light green at base between young and mature ..... *S. yehii*
- Corolla vivid yellow, flowers up to 1.5 cm long (0.8–1.5 cm), style longer than 6 mm (c. 8 mm); adaxial surface of leaflets same color between apex and base..... *S. sensitiva*

Taxonomic treatment

*Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng, sp. nov.

urn:lsid:ipni.org:names:77305894-1

Figs 1A, 2A–D, 3–6

*S. sensitiva sensu acut.* Forbes and Hemsley, J. Linn. Soc., Bot. 23: 170, 1887; Henry, List 32, 1896; Matsumura, Bot. Mag. (Tokyo) 16: 73, 1902; Hayata, Icon. Pl. Formosan. 1: 180, 1911; Hosokawa in Masamune, Short. Fl. Formosa 106, 1936; Chuang and Huang, Leg. Taiwan Past. 93, 1965; Huang and Ohashi in Li, Fl. Taiwan 3: 381, 1977; Huang and Huang, Taiwania 32(1): 88, 1987; Huang and Huang, Flora of Taiwan, 2<sup>nd</sup> edition 3: 364, 1993, *non* Aiton.

**Diagnosis.** The new species is similar to *S. sensitiva*, but can be distinguished by its pale yellow corolla (vs. vivid yellow), often smaller flower and shorter style, and color variation on adaxial surface of leaflets when young and mature, viz. dark green at apex and light green at base.

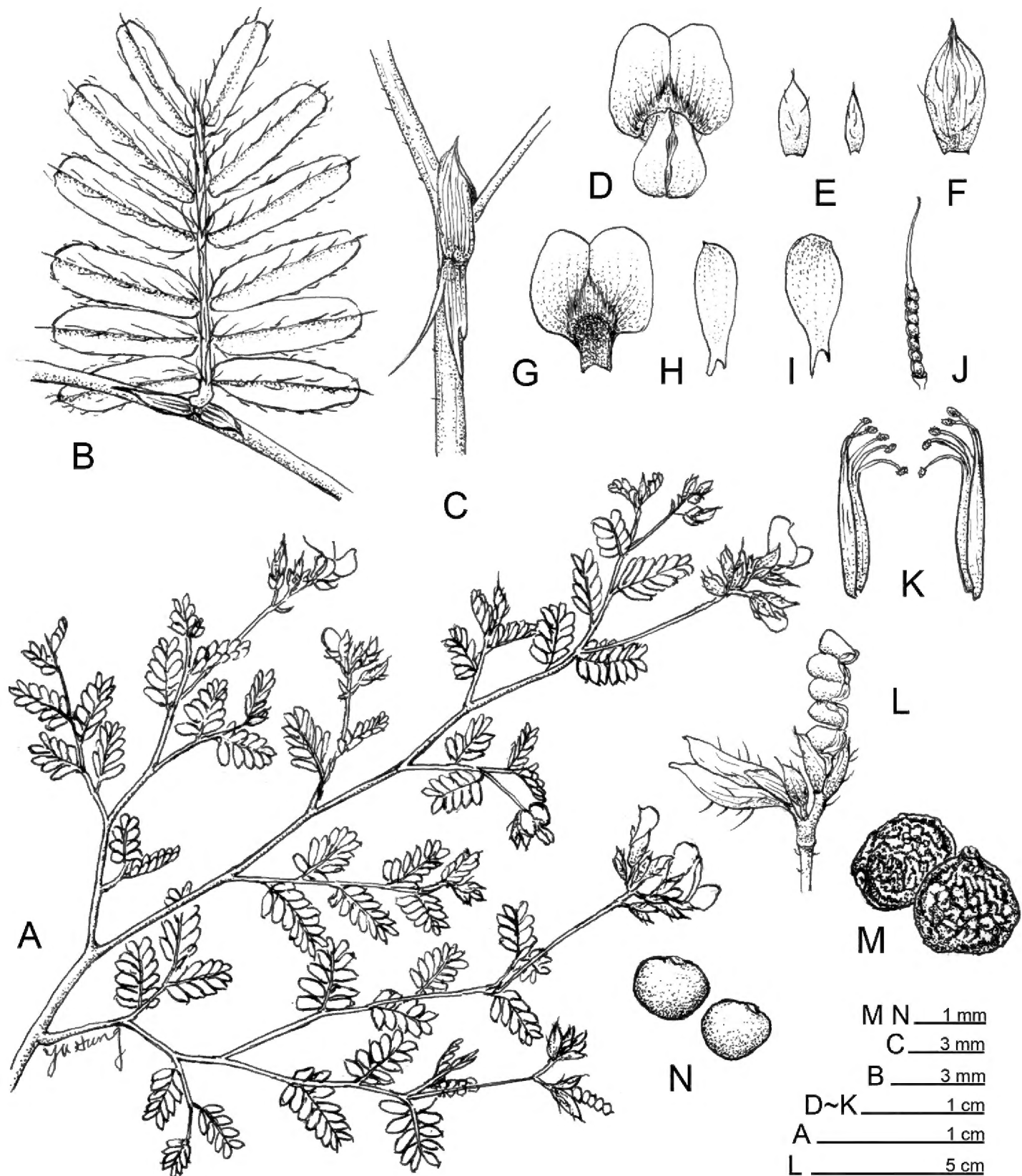
**Type.** TAIWAN. Miaoli County: Tunghsiao Township, Tunghsiao Township 14<sup>th</sup> Cemetery, 81 m alt., 24.44718°N, 120.69563°E, 17 Dec 2021, *C.M.Wang 19231* (holotype: TNM) (Fig. 6).

**Description.** Diffuse annual herb, 25–50 cm long; stem slender, sparsely bristly. Stipules 2.7–5.5 × 1.0–1.6 mm, ovate, striate, scarious, persistent; appendage to the stipules 1.9–3.6 mm long, bilobed. Leaf rachis bristly; petioles 0.9–1.6 mm long; leaflets (2)4–9 pairs, 3.5–7.0 × 1.2–2.3 mm, linear-oblong, obtuse at apex, mucronate, oblique and truncate at base, bristly beneath along the midvein and margins; adaxial surface dark green at apex, light green at base; older leaflets consistently dark green. Racemes axillary, 1.1–3.4 cm long, 1–7-flowered; peduncles filiform, sparsely bristly.

**Table 4.** Students’ *t* scores and *p* values for quantitative characters of pollen grains.

Characters	t score	<i>p</i> value
Polar axis long	-1.753	0.095
Equatorial axis long	-1.687	0.107
P/E ratio	0.227	0.823
Interval between perforations	-2.076	<b>0.044*</b>
Perforation size	-7.361	<b>0.000***</b>

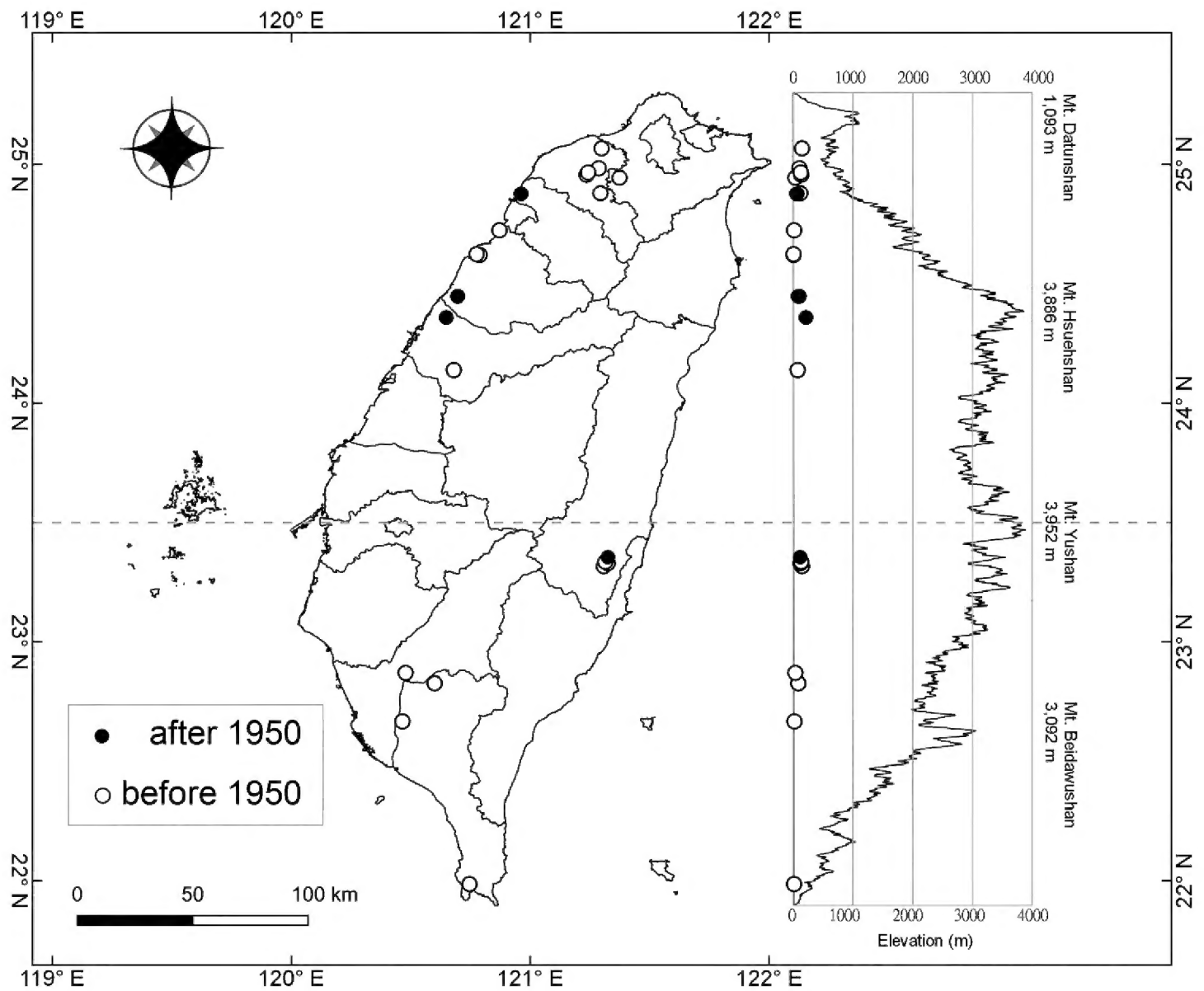
Note: *p* value significance: \**p* < 0.05, \*\* *p* < 0.01, \*\*\**p* < 0.001



**Figure 4.** Line drawings of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng **A** habit **B** leaf (abaxial) **C** stipule **D** flower **E** bracteoles **F** calyx **G** standard **H** wing **I** keel **J** gynoecium **K** diadelphous stamen **L** pod **M** joint of pod **N** seeds.

Flowers 0.7–1.0 cm long; pedicels 1.0–3.1 mm long; bracteoles  $2.3\text{--}4.0 \times 0.9\text{--}2.4$  mm, ovate, striate, persistent. Calyx parallel-veined, lips 4.5–8.2 mm long, equal, ovate, acute at apex, with a few scattered bristles. Corolla pale yellow, standard (5.2)6.2–9.0  $\times$  5.7–8.0 mm, obovate, pale yellow with red circle pattern in centre; wings 4.0–6.9  $\times$  1.8–2.6 mm, oblong, auricled; keels 4.8–7.5  $\times$  1.9–2.5 mm, oblanceolate. Stamens diadelphous; filaments 5.1–6.4 mm long; anthers 0.2–0.3 mm long, ovoid. Ovary





**Figure 5.** Distribution map of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng.

stipitate, 2.2–2.9 mm long, linear, (4)6–7-ovuled; style 3.4–4.1 mm long; stigma pointed. Pods more or less straight, 4.5–8.0 mm long, included, (4)6–7-jointed; joints 1.4–1.6 × 1.2–1.4 mm, papillose. Seeds 1.1–1.3 × 0.9–1.2 mm, reniform.

**Phenology.** Flowering was observed from November to February and fruiting from December to March.

**Distribution and habitat.** Endemic species of Taiwan. *Smithia yehii* grows in wetlands and open places, at elevations of < 300 m (Fig. 5). Common companion species are *Cirsium lineare* (Thunb.) Sch. Bip. (Compositae), *Apluda mutica* L. (Poaceae), *Eriochloa villosa* (Thunb.) Kunth (Poaceae), *Hydrocotyle batrachium* Hance (Araliaceae), and *Ampelopteris prolifera* (Retz.) Copel. (Thelypteridaceae).

**Chinese name.** yè-shìh-po-yóu-gan (葉氏坡油甘).

**Etymology.** The species epithet “*yehii*” was chosen to honor Prof. Mau-Shing Yeh (葉茂生), Department of Agronomy, National Chung-Hsing University, for his contributions to research into the legumes of Taiwan.

**Palynology.** Pollen grains are small, tricolporate, and spheroidal, perforate in surface sculpture, and 19.6–22.7 × 16.5–21.9 μm, P/E ratio 0.9–1.3, perforations 0.2–0.6 μm in diam., and murus width 0.3–1.1 μm (Fig. 2A–D).



**Figure 6.** Holotype of *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng.

**Conservation status.** *Smithia yehii* was evaluated as least concern (LC) by the Editorial Committee of the Red List of Taiwan Plants (2017) as *S. sensitiva*, because there were many records in the herbarium. However, many populations are probably extinct now. *Smithia yehii* is known after 1950 from only four sites (Fig. 5), each of which had only a few individuals (c. < 30) because of human disturbances and habitat fragmentation. Therefore, following the criteria of IUCN (2019), we regard this species as endangered (EN B2ab(ii, iii); C2a(i); D), and recommend that it urgently needs to be protected against extinction.

**Specimens examined.** *Smithia yehii* C.M.Wang, Chih Y.Chang & Y.H.Tseng TAIWAN. **New Taipei City:** Sanxia District, “Ryoenpo” [Lungpuli], 24 Nov. 1910, 36 m alt., *T.Kawakami s. n.* (TAI!); **Taoyuan City:** “Toen” [Toyen], 25 May 1930, 134 m alt., *S.Suzuki* 2627 (PH, TAI!); same loc., 17 Dec. 1933, 125 m alt., *S.Suzuki* 4041 (TAI!); Daxi District, “Taikei” [Tahsi], 31 Mar. 1940, 119 m alt., *T.Nakamura* 4311 (TAI!); Luzhu District, “Toen-Nankan” [Taoyuan-Nankan], 23 Nov. 1931, 147 m alt., *T.Suzuki* 7876 (TAI!); **Hsinchu County:** Chupei City, Lienhua Temple, 19 June 1986, 63 m alt., *T.C.Huang* 12692 (TAI!); same loc., 24 Oct. 1996, 57 m alt., *C.C.Huang* 1619 (TAIE!); same loc., 30 Aug. 1996, 56 m alt., *K.C.Yang* 4969 (HAST!); same loc., 16 Oct. 1997, 56 m alt., *Y.C.Kao* 93 (HAST!); same loc., 29 Nov. 1997, 56 m alt., *W.C.Leong* 667 (HAST!); same loc., 15 Sept. 1998, 68 m alt., *S.C.Liu* 84 (TAIF!); same loc., 23 Aug. 1999, 56 m alt., *C.IPeng* 17683 (HAST!); same loc., 30 Aug. 1996, 57 m alt., *K.C.Yang* 4969 (TNM!); same loc., 15 Sept. 1998, 57 m alt., *S.C.Liu* 84 (TNM!); **Miaoli County:** Houlong Township, “Koryu” [Houlung], 1 Nov. 1924, 6 m alt., *Y.Simada* 1337 (HAST!, TAI!); Tunghsiao Township, Tunghsiao Township 14<sup>th</sup> Cemetery, 27 Oct. 2016, 93 m alt., *T.C.Hsu* 8660 (TAIF!); same loc., 21 Oct. 2017, 103 m alt., *L.H.Yang* 908 (TAIE!); same loc., 2 Dec. 2017, 103 m alt., *R.P.Hsieh* 49 (TAIE!); same loc., 26 Sept. 2019, 93 m alt., *T.C.Hsu* 12070 (TAIF!); same loc., 20 Oct. 2021, 103 m alt., *Z.X.Chang* 2666 (TAIF!); same loc., 11 Dec. 2017, 81 m alt., *C.M.Wang* 17247 (TNM); same loc., 21 Oct. 2017, 81 m alt., *L.H.Yang* 910 (TAIE!); same loc., 1 Mar. 2018, 81 m alt., *M.Y.Shen* 5542 (TAIE!); same loc., 13 Oct. 2021, 81 m alt., *M.Y.Shen* 6841 (TAIE!); same loc., 17 Dec 2021, *Chih Y.Chang* 3620, 3621, 3622 (TCF); Zhunan Township, “Kityo” [Chiting], 3 Aug. 1940, 16 m alt., *Fukuya s. n.* (TAI!); **Taichung City:** “Taityushi” [Taichung], Oct. 1905, 75 m alt., *G.Nakahara s. n.* (PH); same loc., 27 Aug. 1931, 75 m alt., *S.Suzuki* 8217 (TAI!); Dajia District, Mt. Tiehchen, 12 Oct. 1997, 213 m alt., *S.Y.Lu s. n.* (TAIF!); **Kaohsiung City:** Cishan District, “Banshoryo” [Chishan], 1 Nov. 1934, 36 m alt., *S.Suzuki* 5825 (TAI!); **Pingtung County:** Gaoshu Township, “Takagi” [Kaoshu], 8 Nov. 1931, 86 m alt., *T.Hosokawa* 3377 (TAI!); same loc., 8 Nov. 1931, 86 m alt., *T.Hosokawa s. n.* (TAI!); Hengchun Township, “Koshun” [Hengchun], Aug. 1915, 15 m alt., *E.Matuda* 1083 (TAI!); Pingtung City, “Rokkwaiseki” [Liukueitsu], 31 Oct. 1934, 21 m alt., *S.Suzuki* 5713 (TAI!); **Hualien County:** Yuli Township, “Tamazatosyo Nodyo” [Yuli], 28 Aug. 1933, 147 m alt., *Y.Yamamoto* 3099 (TAI!); Hualien County, Yuli Township, “Tamazato” [Yuli], 29 Aug. 1933, 123 m alt., *Y.Yamamoto* 3082 (TAI!); same loc., 29 Aug. 1933, 133 m alt., *Y.Yamamoto* 3087 (TAI!); Yuli, 11 Feb. 1975, 116 m alt., *S.Y.Lu* 3440 (TAIF!).

**Additional specimens examined.** *Smithia sensitiva* Aiton Type: INDIA. “India Orientalis” [Bengal], 1875, *Koenig s.n.*, (holotype: BM, photo!) CHINA. **Fujian Province:** Wuping Country, Mt. Cuiye, 16 Oct. 2017, *T.W.Hsu 21882* (TAIE!); **Guangdong Province:** Huidong County, Gutianshan Nature Reserve, 220 m alt., 23.19310°N, 114.78134°E, 8 Sept. 1984, *Huidong collector team 730* (TNM!); Lianshan County, Shangshuai Town, Lungshuangshan, 150 m alt., 21 Oct. 1999, *F.Y.Zeng 2252* (TNM!); Lianshan County, Shangshuai Town, Lianguan Village, 500 m alt., 13 Oct. 2000, *H.G.Ye 5117* (TNM!); THAILAND. **Chiang Mai Province:** Samoeng district, Samoeng Forest, 1100 m alt., 18.87321°N, 98.78213°E, 24 Nov. 2018, *Chih Y.Chang 2139* (TNM); same loc., 24 Nov. 2018, *C.M.Wang 17941* (TNM); VIETNAM. **Lâm Đồng Province:** Lac Duong District, Cong Troi Waterfall, Lat commune., 28 Oct. 2019, *T.C.Hsu 12222* (TAIF).

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